Assignment 7

Reduction Gears and Related Equipment (Cont'd); Engine Performance and Efficiency

Textbook Assignment: Engineman 1&C, NAVEDTRA 10543-E1, Pages 4-12 through 5-10

Learning Objective: Recognize the components of the controllable pitch propellers and their operating principles.

7-1. In a CRP system, which of the following component(s) form(s) the chamber for the servomotor piston?

1. Hub cone and end cover
2. Hub cone and hub body
3. Head tank
4. Tailshaft

● Question 7-2 is to be judged True or False.

7-2. The hub is secured to the tailshaft by flange bolts which are designed to take torque from the tailshaft.

7-3. To which of the following components are the propeller blades attached?

1. Hub body
2. Bearing ring
3. Crank pin ring
4. Guide pin dowels

7-4. Where is the valve rod assembly located?

1. In the hub
2. In the servomotor
3. In the shaft alley
4. Within the propeller shaft

7-5. From which of the following sources is the hydraulic oil supplied to the hydraulic oil pumps?

1. Engine sump
2. Reduction gear
3. Separate sump
4. Hub oil tank

In answering questions 7-6 through 7-10, select from column B the component of the CRP propeller system that is being described in column A.

A. Description	B. Component
7-6. Provides a direct hydraulic oil connection to the main propulsion shaft	1. OD box
7-7. Contains the major components of the hydraulic system	2. Standby PumP
7-8. Provides a mechanical link between the OD box and the hub servomotor	3. Valve rod assembly
7-9. Mounted at the forward end of main reduction gear housing and driven through a disconnect coupling.	4. Hydraulic oil power module
7-10. Translates to the valve rod in response to control oil commands	

● Question 7-11 is to be judged True or False.

7-11. The primary function of the standby pump is to serve as a backup pump in case of main pump failure.

7-12. When the C/P unit is stabilized, where does the standby pump discharge the oil?

1. To the servosystem
2. To the gravity tank
3. To the lower oil tank
4. To the upper gravity tank

7-13. What is the main purpose of the upper gravity oil tank?

1. To recycle the control oil
2. To act as a backup to the CRP system
3. To maintain a static head pressure on the hub
4. To serve as a ready reserve to the OD box

Learning Objective: Indicate the procedures to follow when inspecting gears and related equipment.

7-14. Before any inspection plate to the main reduction gear is lifted or opened, permission must first be obtained from which of the following personnel?

1. Commanding officer
2. Main propulsion officer
3. First lieutenant
4. Engineer officer

7-15. Assume the main reduction gear inspection plates are opened to check the tooth contact of the pinions and bull gear. What information should be entered in the Engineering Log after the inspection plates are secured?

1. The name of the officer who witnessed the closing of the inspection plates
2. The statement that the inspection showed no foreign matter had entered the casing
3. The statement that the inspection showed that the oil-spray nozzle lines were open and clear of any obstructions
4. All of the above

7-16. Reduction gear inspection plates should be opened and the gears and oil-spray nozzles inspected at least once each

1. week
2. month
3. quarter
4. year

● Question 7-17 is to be judged True or False.

7-17. A 7-year inspection of the main reduction gear should be requested and the necessary repairs conducted by a naval shipyard if alignment trouble is suspected.

7-18. If a submerged object is struck by a ship's propeller, when should the main reduction gear be inspected?

1. Immediately
2. After the ship is drydocked
3. After the ship is docked or anchored
4. When it shows signs of malfunctioning

7-19. When should the flexible couplings between turbines and reduction gears be inspected?

1. Prior to full power trials
2. After a full power trial
3. Prior to shipyard overhaul
4. During shipyard overhaul

7-20. Which of the following operations is NOT usually carried out just before a full power trial?

1. The opening of the gear casing
2. The inspection of the contact of the gear teeth
3. The checking of the operation of the oil-spray nozzles
4. The inspection of the oil-spray nozzle strainers

7-21. A 2-hour full power trial has just been completed and you are directed by proper authority to check the main gear. Which of the following actions will you take?

1. Inspect the main thrust bearing clearance
2. Inspect the gear tooth contact
3. Inspect the condition of the gear teeth
4. Each of the above

Learning Objective: Point out the safety precautions which are applicable to reduction gears, shafts, and bearings.

7-22. What must you do if the bull gear churns and aerates the oil?

1. Slow or stop the engine until normal conditions are restored
2. Remove some of the oil without changing the engine speed
3. Stop the engine, and drain and replace the oil
4. Stop the engine and add some fresh oil

7-23. Gears should be slowed down or stopped altogether when which of the following conditions occur?

1. Oil is emulsified in the gear case
2. Unusual noises are heard
3. Both 1 and 2 above
4. Bearing temperature are below normal

7-24. When should the main shafts be locked?

1. When the divers are inspecting damaged propellers
2. When strong currents are present at anchorage
3. When the ship is underway
4. At all of the above times

7-25. Which of the following conditions should be in effect when the main shaft of a ship is allowed to trail?

1. The windage temperature in the low-pressure casing is kept at a maximum
2. The lubricating system must be operating
3. The shaft brake must be engaged
4. The turning gear must be engaged

7-26. Which of the following gears must be disengaged before the main engines are started?

1. Reduction
2. Turning
3. Pinion
4. Bull

Learning Objective: Point out factors that affect the power output of an engine and recognize the terms and formulas used in computing engine performance and efficiency.

7-27. Which of the following characteristics will affect the efficiency and performance of internal combustion engines?

1. Engine design
2. Compression ratio
3. Operating temperatures
4. Each of the above

7-28. To calculate the indicated horsepower of an engine, you need to know the indicated mean effective pressure and what other factor?

1. The engine speed
2. The brake horsepower
3. The fuel consumption rate
4. The brake mean pressure

7-29. What is the speed of a piston if the rotation speed of the crankshaft is 1,000 rpm and the piston stroke is 12 inches?

1. 1,260 fpm
2. 2,000 fpm
3. 12,000 fpm
4. 24,000 fpm

7-30. When the engine rpm drops below rated speed, what usually happens to the brake mean effective pressure?

1. It remains the same
2. It decreases
3. It increases
4. It increases and then decreases

7-31. If an engine is operated for long periods at idling speed, how frequently will overhaul be necessary?

1. More frequently than if operated at 50% of load
2. Less frequently than if operated at 100% of load
3. As frequently as if operated at 75% of load
4. Less frequently than if operated at 90% of load

7-32. An unbalanced cylinder load is indicated by which of the following conditions?

1. Black exhaust smoke
2. High exhaust temperatures
3. Low cooling water temperature
4. Low lubricating oil temperature

7-33. What happens to the lubricating oil that leaks past newly installed piston rings into a cylinder?

1. It drains into the sump
2. It burns in the cylinder
3. It collects on the piston crown
4. It passes out of the cylinder into the exhaust

7-34. An unbalanced cylinder will cause which of the following effects?

1. It will gum up the combustion spaces
2. It will score the cylinder wall
3. It will corrode the piston crown
4. It will overheat the engine

7-35. Engine efficiency is measured by the relationship between energy input and what other factor?

1. Temperature of exhaust
2. Amount of fuel consumed
3. Temperature of combustion
4. Amount of power developed

7-36. Compression ratio refers to the relation between the volume of air above a piston when it is at top dead center and what other factor?

1. The volume of air below the piston when it is at top dead center
2. The volume of air above the piston when it is at bottom dead center
3. The pressure of the air above the piston when it is at top dead center
4. The temperature of the air below the piston when it is at bottom dead center

7-37. Why is the efficiency of the Otto cycle less than that of the diesel cycle?

1. Because the Otto cycle reaches a higher temperature
2. Because the Otto cycle has a lower compression ratio
3. Because the Otto cycle uses a greater amount of air
4. Because the Otto cycle uses a smaller amount of air

7-38. Assume that an engine has an indicated horsepower of 1,600 and uses 400 pounds of fuel per hour. If the fuel has a value of 20,000 Btu per pound, what is the indicated thermal efficiency of the engine?

1. 40.9%
2. 49.4%
3. 50.9%
4. 53.2%

7-39. If an engine consumes 70 pounds of fuel in an hour and the fuel has a potential energy of 20,000 Btu per pound, what is the potential power of the engine? (Use the factor of 2545 Btu per hr/hp.)

1. 36.4 hp
2. 55.0 hp
3. 363.6 hp
4. 550.1 hp

7-40. The overall thermal efficiency of an engine is 50 percent and the brake horsepower is 1,450.00 Btu per hour. What is the value of the heat input of fuel?

1. 725,000 Btu per hr
2. 1,450,000 Btu per hr
3. 2,000,000 Btu per hr
4. 2,900,000 Btu per hr

7-41. Which of the following factors has the greatest effect on the mechanical efficiency of an engine?

1. Vaporization
2. Corrosion
3. Friction
4. Combustion

7-4 2. What is the relationship between the amount of friction between the moving parts of an engine and the speed of the engine?

1. Friction increases at high speeds
2. Friction decreases at low speeds
3. Friction remains constant throughout the speed range
4. Friction increases at low speeds and decreases at high speeds

● Information for questions 7-43 through 7-53: A 6-cylinder, single-acting, 2-stroke cycle, diesel engine has a mean effective pressure of 104 psi per cylinder when operating at full load and rated speed of 2,500 rpm. The stroke and cylinder bore are 5 inches and 4 inches, respectively. The engine's frictional horsepower is 32 hp and does not change with changes in load or speed. At 2,000 rpm, the brake horsepower for the engine is 166 hp.

7-43. What is the approximate indicated horsepower for the engine at 2,500 rpm?

1. 200 hp
2. 216 hp
3. 232 hp
4. 247 hp

7-44. Under full load at 2,500 rpm, the average pressure exerted on a piston of the engine during each power stroke is

1. 17 1/3 psi
2. 52 psi
3. 104 psi
4. 208 psi

7-45. What effect does a 4-psi drop in cylinder mean effective pressure have on the power developed by the engine at 2,500 rpm?

1. Fewer decreases since cylinder bmep exceeds 100 psi and engine speed drops
2. Power decreases since cylinder temperature drop and quality of combustion is impaired
3. Fewer increases since cylinder bmep exceeds 100 psi and engine speed rises
4. Power increases since cylinder temperature rises and quality of combustion improves

7-46. Which of the following expressions is used to compute brake horsepower at 2,500 rpm?

1. ihp - 32
2. ihp + 32
3. (ihp - 32)ihp
4. (ihp + 32)ihp

7-47. The approximate brake mean effective pressure at 2,000 rpm is

1. 81 psi
2. 87 psi
3. 93 psi
4. 102 psi

7-48. What is the engine's maximum mechanical efficiency?

1. 81.3%
2. 72.4%
3. 87.0%
4. 90.5%

7-49. What is the approximate mechanical efficiency of the engine when operating under half load at 2,000 rpm?

1. 72%
2. 81%
3. 84%
4. 87%

7-50. The maximum mechanical efficiency for this engine multiplied by 104 psi should be equivalent to bmep under which of the following conditions?

1. Half load and 2,000 rpm
2. Full load and 2,500 rpm
3. No load and 2,500 rpm
4. No load and 2,000 rpm

7-51. Which of the following factors limit the power that each piston of the engine can develop during a power strike?

1. Frictional heat
2. Scavenge efficiency
3. Heat losses due to incomplete combustion
4. Each of the above

7-52. If the volumetric efficiency of a 4-stroke engine is 50 percent, the amount of air drawn into a cylinder is

1. equal to the amount of air that would enter the cylinder under ideal conditions
2. half the amount of air consumed by combustion
3. half the amount of air that would enter the cylinder under ideal conditions
4. twice the amount of air consumed by combustion

7-53. How is scavenge efficiency of a 2-stroke cycle engine determined?

1. By measuring the air required for combustion
2. By measuring the amount of burned gases removed from the cylinder
3. Both 2 and 3 above
4. By measuring the amount of fresh air entering the cylinder

7-54. The amount of heat lost by an engine cylinder through the exhaust is determined by the temperature in the cylinder

1. when exhaust begins
2. after the charge is drawn in
3. just before compression begins
4. immediately after combustion occurs

7-55. When exhaust valves are timed late, what will be the effect on the operation of an engine?

1. Energy losses will increase due to heat loss
2. The engine will lose pressure before all available work is obtained
3. Insufficient amount air will enter the cylinders for completed combustion of the next charge
4. Both 1 and 3 above